Active Project (2016 - 2016)

Accident Tolerant Reactor Shutdown for NTP Systems, Phase I Project

SBIR/STTR Programs | Space Technology Mission Directorate (STMD)

ABSTRACT

In this SBIR, USNC will develop an accident tolerant reactor shut-down system for Nuclear Thermal Propulsion (NTP) systems that will guarantee sub-criticality in the event of a water submersion accident. Reactor shut down during a water submersion accident is a crucial issue that must be addressed in NTP systems. The technology that USNC will develop in this SBIR is a low risk design feature that has notable advantages over existing reactor shut-down systems during water submersion accidents. USNC's accident tolerant reactor shut-down system will consist of enhanced control drums with significantly more criticality worth. USNC's enhanced worth control drums are a low risk modification to the traditional control drum where a small amount of fuel is added opposite to the neutron absorber. In addition, USNC's enhanced worth control drums will be moved deeper into the active core to further enhance the criticality worth of the control drums. The combination of adding fuel and moving the drums deeper into the active core will substantially increase the shutdown margin of the control drums and will be sufficient to maintain sub-criticality in the worst case water submersion accidents. Neutronic analysis codes such as MCNP6 and Serpent 2 will be utilized.

ANTICIPATED BENEFITS

To NASA funded missions:

Potential NASA Commercial Applications: NTP and its supporting technologies have great promise in spreading human presence to Mars and other locations beyond low earth orbit. USNC's accident tolerant reactor shutdown technology will address the water submersion criticality accident for NTP systems and help make NTP a viable technology to fulfill NASA human exploration needs. USNC's work directly aligns with the NASA Technological Roadmap 2015 TA 2: In-Space Propulsion Technologies: 2.2.3 Thermal Propulsion. Currently, NTP is being

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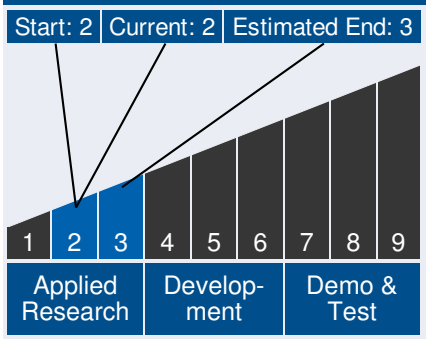
Technology Maturity



Management Team

Program Executives:

- Joseph Grant
- Laguduva Kubendran

Program Manager:

- Carlos Torrez

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investigated for a human Mars Mission in the 2030s time frame, but a NTP system would be a game changing technology that would have application for a multitude of missions. In addition, USNC's accident tolerant reactor shutdown technology can be applied to small nuclear systems for space or surface power. These systems, like NTP systems, must also remain sub critical during a water submersion accident.

To the commercial space industry:

Potential Non-NASA Commercial Applications: The market for the NTP system and its supporting technologies extends beyond NASA with numerous potential customers in the private industry and defense sector. NTP is a game changing technology that is difficult to quantify in the non-NASA market but has the potential to be very large. USNC is currently pursuing earth based mobile reactors and small modular reactors. These reactors are different than traditional reactors as they can be shipped in whole or modular sections. In the shipment of these reactors it is essential to ensure that they are subcritical during water submersion (much like space reactors). The technology developed in this SBIR may have application in addressing water submersion in these earth-based reactors. In addition, a number of other companies are trying to bring mobile or small modular reactors to the market, creating a clear opportunity to implement the novel technology developed in this SBIR. The market potential for advanced reactors is several billions dollars and approximately 40 U.S. companies are trying to bring advanced nuclear technology to the market backed by a total of more than 1.3 billion dollars of private investment.

Management Team *(cont.)*

Principal Investigator:

- Paolo Venneri

Technology Areas

Primary Technology Area:
In-Space Propulsion Technologies (TA 2)
└ Non-Chemical Propulsion (TA 2.2)
  └ Thermal Propulsion (TA 2.2.3)

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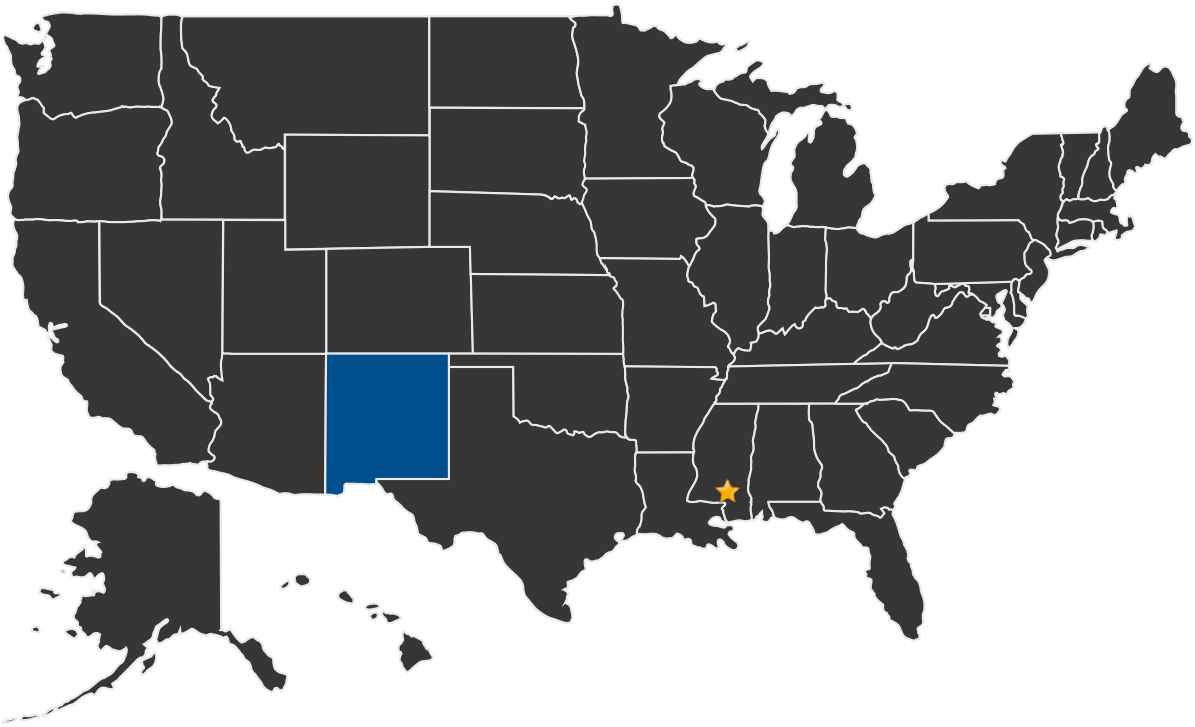
U.S. WORK LOCATIONS AND KEY PARTNERS



U.S. States With Work

Lead Center:
Stennis Space Center

Other Organizations Performing Work:

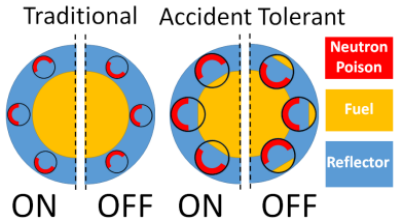
- Ultra Safe Nuclear Corporation (Los Alamos, NM)

PROJECT LIBRARY

Presentations

- Briefing Chart
  - (http://techport.nasa.gov:80/file/23306)

IMAGE GALLERY



Accident Tolerant Reactor Shutdown for NTP Systems, Phase I

DETAILS FOR TECHNOLOGY 1

Technology Title

Accident Tolerant Reactor Shutdown for NTP Systems, Phase I

Potential Applications

NTP and its supporting technologies have great promise in spreading human presence to Mars and other locations beyond low earth orbit. USNC's accident tolerant reactor shutdown technology will address the water submersion criticality accident for NTP systems and help make NTP a viable technology to fulfill NASA human exploration needs. USNC's work directly aligns with the NASA Technological Roadmap 2015 TA 2: In-Space Propulsion Technologies: 2.2.3 Thermal Propulsion. Currently, NTP is being investigated for a human Mars Mission in the 2030s time frame, but a NTP system would be a game changing technology that would have application for a multitude of missions. In addition, USNC's accident tolerant reactor shutdown technology can be applied to small nuclear systems for space or surface power. These systems, like NTP systems, must also remain sub critical during a water submersion accident.